Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

BAO01-04 Room:301A Time:May 21 10:00-10:15

Organic compounds in interplanetary dust particles and their relevance to origins of life

Kensei Kobayashi[1*], Yukinori Kawamoto[1], Takuto Okabe[1], Takeo Kaneko[1], Yumiko Obayashi[1], Kazuhiro Kanda[2], Hajime Mita[3], Hikaru Yabuta[4], Kazumichi Nakagawa[5], Kyoko Okudaira[6], Hajime Yano[7], Hirofumi Hashimoto[7], Shin-ichi Yokobori[8], Akihiko Yamagishi[8]

[1]Yokohama National University, [2]University of Hyogo, [3]Fukuoka Institute of Technology, [4]Osaka University, [5]Kobe University, [6]Aizu University, [7]JAXA/ISAS, [8]Tokyo University of Pharmacy and Life Science

Organic compounds including amino acid precursors and nucleic acid bases have been detected in carbonaceous chondrites, and glycine was detected from the captured cometary dust. These organics have been discussed in the context of possible organic sources for the first terrestrial life. It was suggested that more organic carbons were delivered to the early Earth by interplanetary dust particles (IDPs) than by meteorites or comets [1]. A demerit of IDPs for the carriers of extraterrestrial organics is that IDPs are so small that they are directly exposed to solar radiation that might decompose organics. Thus the presence of bioorganics in IDPs is expected, but it is difficult to judge it since IDPs (or micrometeorites) are so small and they have been collected in the terrestrial biosphere. Thus it would be of importance to study possible alteration of IDP organics in space environments, and to collect pristine IDPs out of the terrestrial biosphere.

Since carbonaceous chondrites and comets contain such organic compounds as amino acids or their precursors, IDPs that seem to be formed from meteorites and comets can also contain them. In order to study possible alteration of bioorganic compounds in IDPs, amino acids, amino acid precursors and nucleic acid bases were irradiated with high-energy particles and high-energy photons to simulate the actions of cosmic rays and solar radiation, respectively. We used glycine and isovaline as free amino acids since they are found abundant in carbonaceous chondrites. Their possible precursors, hydantoin and 5-ethyl-4-methyl hydantoin, and complex amino acid precursors synthesized from a mixture of CO, NH_3 and H2O (hereafter referred to as CAW) [2] were also used as irradiation targets. These molecules were irradiated with continuous light from soft X-rays to IR (hereafter referred to as soft X-rays) at the beam line 6 of NewSUBARU (the synchrotron facility of University of Hyogo). They were also irradiated with heavy ions from HIMAC (NIRS, Chiba). Irradiated samples were evaluated by amino acid analysis after acid-hydrolysis and/or by C-XANES by using the beam line 5 of NewSUBARU. Nucleic acid bases (adenine etc.) were also irradiated with soft X-rays and with heavy ions, and recovery was also determined by HPLC.

Amino acid precursors were more stable against soft X-rays than free amino acids. Water-insoluble products were formed after soft X-rays irradiation. Nucleic acid bases were more stable than amino acids and their precursors against the irradiation. Heavy ions were generally less effective than soft X-rays for decomposition or alteration of the molecules examined.

We are planning a novel astrobiology mission named Tanpopo by utilizing the Exposed Facility of Japan Experimental Module (JEM/EF) of the International Space Station (ISS). Two types of experiments will be done in the Tanpopo Mission: Capture experiments and exposure experiments.

References:

[1] Chyba C. F. and Sagan C. (1992) *Nature* **355**, 125-132.
[2] Takano Y. et al. (2004) *Appl. Phys. Lett.* **84**, 1410-1412.
[3] Yamagishi A. et al. (2009) *Trans. JSASS Space Tech. Jpn* **7**, No. ists26, Tk_49-55.

Keywords: interplanetary dust particles, amino acids, origins of life, complex organic compounds, soft X-rays, the Tanpopo Mission